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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PS 1775 for a patent by ENVIROFUEL IP PTY LTD as filed on 16 April 2002.

WITNESS my hand this
Eighth day of May 2003

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant:

ENVIROFUEL IP PTY LTD

Invention Title:

REFINING PROCESS AND APPARATUS

The invention is described in the following statement:

REFINING PROCESS AND APPARATUS

The present invention relates generally to the treatment of waste material, particularly to the treatment of waste materials produced from industrial, commercial or domestic processes, such as for example manufacturing processes, food preparation and cooking processes or the like. More particularly, the present invention relates to a method and apparatus for separating useful components or recoverable materials from the waste material produced in manufacturing or other processes by refining the waste material to remove unwanted materials so that the recovered useful components can be used, recycled on further processed. Even more particularly, the present invention relates to refining industrial wastes of the type containing fats, oils and greases or the like (FOG) to recover the FOG materials so that they can be reused, particularly as a fuel, such as a non bio-diesel fuel, in a variety of different situations, such as for example, in power generation installations within an industrial complex, for the generation of electricity for use in supplying power to communities, for use in industrial plants or for feeding electricity back into the normal grid of the electricity supply of a state, city, region or the like. The present invention finds particular application as a cost effective way of disposing of aqueous mixtures of greasy waste materials so that the refined or recovered materials can be used as either a fuel or as one component of a fuel in engines, such as internal combustion engines, compression engines, hydrogen assisted combustion engines or the like for generating electricity, power heat or other requirements. By refining the greasy waste material to recover the greasy materials, such as the fats, oils and greases from fast food outlets or the like, separate the water from the greasy materials.

Although the present invention will be described

with reference to one particular example of the present invention involving the recovery of fats, oils and greases from fast food outlets using one form of separation apparatus to provide refined products for use as fuels, it is to be noted that the scope of the present invention is not limited to the described embodiment but rather the scope of the present invention is more extensive so as to include the treatment of a wide variety of diverse materials including materials other than fats, oils and greases emanating from fast food outlets, and the use of other types of separation apparatus, and methods or processes other than the recovery of fats, oils and greases.

The amount of industrial processes, including manufacturing processes, such as for example, the preparation of foods and beverages including fast foods, such as chicken meals, hamburgers or the like is increasing so that increasing amounts of waste products are being formed as a result of the increased use of these processes. The waste material emanating from such processes contains potentially useful or valuable materials. In the past, the waste material was dumped or otherwise disposed of leading to the loss of valuable resources and the wastage of materials which potentially could be recovered and reused.

The dumping of these materials in landfill and other environmentally sensitive areas contributed to the inefficient use of valuable resources and to the cost of the overall manufacturing or preparation process since the cost of dumping the waste materials needed to be taken into account and the cost of the process could not be offset by the subsequent use or reuse of any recovered products.

Furthermore, the indiscriminate dumping of waste materials is environmentally unacceptable and introduces a further range of problems including contamination of ground water and the like. Thus, the dumping of waste

materials was neither economically or environmentally desirable.

In the past whilst it had been recognized that the waste materials could be treated so as to recover valuable components from the waste material, the technology for efficiently recovering the useful components was either not available or was too expensive to operate to be cost effective resulting in the treated materials being too expensive for economical reuse or further processing or the like. Furthermore, the use or production of renewable energy is now assuming greater importance within the environmental industry. Presently, fat, oil and grease from grease traps is difficult to treat and/or re-process at a cost that results in a viable product, such as for example, the production of tallow for use in the cosmetic industry and/or in other industrial processes. Therefore, there is a need for a more efficient and cost effective method of processing 'grease' type products that are recoverable from grease traps, sumps, pits, or the like.

There is also a need for a method and apparatus for treating waste materials to recover useful components in a form that allows the useful components to be used, recycled or further processed in such a way that the operation of the method and apparatus is economically viable and/or the value of the recovered products makes their reuse economically viable.

The present invention sets out to address these problems by providing a method and apparatus which is economic in operation, is efficient and results in valuable components of a waste material being recovered in a form which allows the recovered products to be used economically.

In particular, the present invention finds application in treating waste materials containing fats, oils, greases, solids and the like in aqueous mixtures to recover the fat, oil and grease components so that the

recovered components are in a form or of a purity that allows the produce to be readily reused.

According to one aspect of the present invention, there is provided a method of refining a waste material having or containing an oil or oleo material or an oil-like material as one useful component of the waste material by separating the useful component from the remaining components of the waste material including the steps of introducing the waste material into a first separation apparatus to a least a partially separate the waste material into at least two portions thereby partially refining the waste material into a partially refined portion, conveying the at least partially refined portion to a second separation apparatus to further separate the partially refined portions into at least two further portions wherein one of the further separated streams contains the useful component thereby further refining the partially refined portion into a substantially refined portion and collecting the substantially refined portion containing the one useful component for subsequent use and/or processing wherein at least one of the portions being substantially free or partially free of the useful component can be used, recycled or further processed to improve the efficiency or economics of the refining process or the use of the waste material.

Typically, the waste material is an aqueous mixture. More typically the waste material is an aqueous mixture containing fats, oils, greases, solids and the like. Even more typically the waste material contains 40% of fats, oils, greases and 2% of suspended solids and about 58% water.

Typically, the first separation apparatus is a cyclonic evaporator in which the introduced waste material is separated into a first portion or stream being substantially water vapor or water and a second portion or stream which is a combination of water, water vapor and

useful component.

Typically, the second apparatus is a cyclonic evaporator. More typically, further water or steam is separated from the partially refined waste material stream to form a substantially refined stream in the cyclonic evaporator.

Typically, the refined product is a fat, oil or grease or other essentially oleo type material or hydropholine type material that is combustible. More typically, the refined product is a fuel or a component of a fuel or is capable of being used as a fuel. More typically, the fuel is suitable or adapted or modified as a fuel for an engine.

Typically, the waste material is dewatered. More typically, the waste material is collected as grease trap waste and is dewatered to contain about 40% grease, 2% solids and 58% water.

Typically, the engine in which the recovered or refined component is used as a fuel or as one component of the fuel is an internal combustion engine, a compression engine or a hydrogen assisted combustion engine. More typically, the engine is used to generate electricity or power.

The present invention will now be described by way of example with reference to the accompanying drawings in which

Figure 1 which is a flow-chart of one form of the process of the present invention,

Figure 2 is a schematic top perspective view of one arrangement of the apparatus for carrying out the process of the present invention.

Waste, typically in the form of greasy waste, from manufacturing processes including food and beverage manufacturing processes, food preparation processes, including fast food preparation establishments, and other commercial, industrial or domestic installations is collected and optionally stored, such as for example in a

holding tank (not shown). A conduit 2 is connected to the holding tank or extends directly from a transportation tanker or similar (not shown) for delivering incoming waste, particularly an aqueous mixture of grease or related products. Waste in conduit 2 is conveyed to a heated feed tank 4 provided with an inlet 6 for receiving the greasy waste, a side mounted agitator or stirrer 8 for agitating the heated contents of tank 4 in order to keep the contents of the tank liquid and mobile.

Tank 4 is provided with a recycling outlet 9 and conduit 10 for recycling unsuitable waste products through cavity feed pump 12 to a separation apparatus, such as for example a vertical gravity separator (VGS) or similar 13 for separating oil and water from the greasy waste for recycling to tank 4 through conduit 14. Clean water is discharged in a suitable or convenient manner from VGS 13, such as for example, through outlet and conduit 15 for disposal in an environmentally acceptable manner.

Tank 4 is provided with a side mounted outlet 16 extending from the side of tank 4 and a conduit 18 for discharging heated waste from tank 4 and for conveying the heated waste through conduit 18 by pump 22. A conduit 24 extends from pump 22 through heat exchanger 26 to the top of a first separating apparatus in the form of a cyclonic evaporator, known as a cyclovap calandria 28 or similar which uses the production of steam to separate the oil like components from the waste. The greasy waste is admitted to calandria 28 through inlet 30 located at or towards the top of the calandria. Separation of the water and oleophilic material such as fats, oils, greases and the like takes place in calandria 28. Calandria 28 is provided with a waste outlet 31 located at or towards the base of the calandria. A conduit 32 extends from outlet 31 of calandria 28. Conduit 32 is divided into a further conduit 34 leading to a first separator tank pot vessel 42 or the like and a second conduit 36 leading via cyclovap re-circulation pump 38 and conduit 40 back to conduit 24

between heat exchanger 26 and calandria 28 for recycling greasy waste material not separated in cyclovap calandria 28 back into the calandria 28 for further processing and separation. Partial separation and refining of the waste material occurs in calandria 28 by removal of water in the form of steam from the aqueous waste material.

Conduit 34 is connected to the inlet of the first separator pot 42 where the mixture of steam and FOG emanating from calandria 28 is further separated into a vapor stream which is discharged through outlet 44 of separator pot 42 and conduit 46 for subsequent processing or use, including recycling as will be described in more detail later in this specification. Separated fats, oils and greases are discharged through outlet 48 of separator pot 42 into conduit 50 by means of pump 52 to the top of a second calandria or cyclonic evaporator or similar apparatus 54. First outlet 56 of calandria 54 is for use in conveying steam through conduit 58 for subsequent use, re-use or processing. A second outlet 60 is located at or towards the base of calandria 54 for discharging separated fat, oil, grease, and the like through conduit 62. Conduit 62 divides into a first conduit 64 and a second conduit 66. Second conduit 66 is for recycling FOG through cyclovap re-circulation pump 68 and conduits 66 and 50 for re-admission to the top of calandria 54 for subsequent processing to further refine the FOG of the waste material.

Conduit 64 conveys FOG to a second separator pot, tank vessel or the like 65 where further separation of steam and refined FOG takes place. Steam is discharged from pot 65 through outlet 67 and conduit 68 for use, re-use or subsequent processing.

Another outlet 70 is located at or towards the base of separator 65 for discharging refined fats, oils and greases which are conveyed through conduit 72 to a final product holding tank 74 fitted with a side mounted agitator stirrer 76 or similar for agitating the contents

of the final product holding tank.

In one embodiment holding tank 74 is provided with a first outlet 78 and a first conduit 80 for discharging hot refined product from final product holding tank 74 to a road tanker 81 or similar vehicle or the like for transporting refined product to a remote location for subsequent use or further processing. In this embodiment the refined product may be used in a variety of different ways. One way is as fuel for a variety of uses including heating oil, fuel for an internal combustion or compression engine or the like.

In another embodiment holding tank 74 is provided with a second outlet and conduit 82 for conveying refined product to a centrifical separator 84 where the refined product is further refined so as to remove any solid impurity or other contaminated material before the fully refined product is conveyed to a diesel engine 86 or similar for generating electricity or power. In one embodiment the power is used to operate the refining installation of the present invention. In another embodiment the generator is used to produce electricity for an industrial, manufacturing or commercial plant, community or similar, or a combination of different uses, all requiring the generation of electricity. Control panel 88 controls the distribution of electricity.

In one preferred form of the present invention the refined product is used as the fuel or as one component of the fuel of a diesel engine generator or a engine using hydrogen assisted combustion for generating power. It is particularly advantageous to use the refined product as a fuel in a hydrogen assisted combustion engine for generating power, most suitably in the form of electricity, for providing energy for an industrial complex, community or the like.

In one embodiment conduit 82 is provided with a heat exchanger (not shown) using the steam generated from the refining of the FOG to further heat the refined

product before admitting the product to the diesel generator or similar to assist the efficiency of combustion.

In operation of one form of the installation of the present invention, the greasy waste admitted to tank 4 through conduit 2 is typically of a composition of 50% oil or oleophilic-type products and 50% water, more typically a composition of 40% grease or other oleophilic type components, 2% solids, and 58% water. This material is heated in tank 4 to a temperature of about 90°C. Tank 4 is agitated by stirrer 8 to provide a homogeneous mixture thereby preventing pre-separation of the FOG from the water prior to the waste mixture entering the first calandria 28. The waste material is pumped by pump 22 through heat exchanger 26 into the first calandria 28 where first phase separation occurs by vaporising the water of the waste material. The vapour discharged from calandria 28 along with the partially refined steam is pumped into separator pot 42 where it is separated and pumped as steam to calandria 54 where the moisture content of the waste material is reduced to about 5%. The concentrate of the refined product in the stream which is discharged through outlet 60 of second separator 54 is about at least 95% oil/ grease and similar products. The stream of refined product which is discharged from tank 65 at about 95°C, is conveyed to holding tank 74 which is maintained at about a temperature 70°C where the refined oil product is stored at this temperature. If the refined oil product is used directly from final product holding tank 74, it can be passed through a suitable heat exchanger to reduce the temperature further before being used as a fuel or similar.

In one embodiment steam emanating from the first and second calandria is conveyed to a suitable apparatus, such as for example an aroma tank 98 for converting to water for subsequent recycling or further processing or the steam may be pumped under pressure to holding tank 4

where it is used to dilute the concentration of fats, oils and greases in the holding tank. In another embodiment, still further portions of the steam are used to heat the contents of the holding tank by passing the steam through a heat exchanger associated with the holding tank, as shown in figure 1 with reference to heat exchange 90.

In further operation of the apparatus and method of the present invention vapour separated in first separation pot 42 is collected and passed through outlet 44 to conduit 46 to second calandria 54. Vapour being discharged through outlet 60 is conveyed by conduits 62,64 to second separation pot 65 where it is discharged through outlet 67 and conveyed via conduit 69 to a first radial compression fan 94 which increases the temperature from about 95°C to 100°C or higher. The heated vapour being discharged from first radial compression fan 94 is passed to the inlet of a second radial compression fan 96 through conduit 95. The vapour after passing through the second radial compression fan 96 is discharged at a temperature between 100°C-110°C into conduit 97. The steam from the second recompression fan 96 is conveyed by conduit 97 for re use in first calandria 28 thus commencing the separation and refining process once again. By using recompression fans the need for continuous steam is eliminated thus reducing dramatically the cost of operating the apparatus and method of the present invention by obviating the need to supply fresh preheated steam to the method and apparatus.

Steam or vapour discharged from first calandria 28 and second calandria 54 is conveyed by conduits such as conduit 58 to the aroma tank 98 for subsequent treatment, such as for example recycling to holding tank 4 or venting to atmosphere or condensation to form a water supply for a variety of uses including subsequent steam generation.

Furthermore, other modifications of the steam/water vapour/water processing and use of the present invention are contemplated such as the condensation of

steam to form demineralised water and the production of steam for other uses.

Another modification of the present invention includes incorporating a vertical gravity separator (VGS) at a restaurant or take away food establishment for separating much of the fat, oil and grease from the waste water so as to reduce the amount of water to be transported from the restaurant or similar to the location of the apparatus of the present invention. Using a vertical gravity separator or similar it is possible to obtain a 50% reduction in the amount of water being collected and transported. The reduction in the amount of water being separated and transported dramatically reduces the transportation cost to a transport company. Instead of previously having to use one suction truck to empty a grease trap by collecting 2,000 litres of predominantly water monthly it is possible to remove 200-300 litres of grease every two months. By utilising the VGS at the restaurant or similar it is possible to reduce the need to process up to 90% of the water being discharged from the restaurant or similar. This would allow each truck to collection concentrated grease from each pick up point thereby allowing 10-15 collections of concentrated grease per trip rather than being limited to only two collection per trip because of the large volume of water being collected. Once the waste material is delivered to the installation of the present invention it would undergo a pretreatment by heating the waste material and filtering the material to remove any solids having a particle size of greater than 2 mm. The pre treated waste material would then be treated in accordance with the present invention by being admitted through conduit 2 and so on.

In another embodiment of the present invention which embodiment uses the refined product produced by the method of the present invention as a fuel the recovered FOG is delivered to the engine installation having the following characteristics. The refined product is made

available at about 70°C having less than 3% moisture and containing particle of no more than 2 micron or less and a calorific value of between about 35 and 41 mgl/kg.

In this embodiment the refined oil is transferred to a jacketed fuel tank at a predetermined temperature such as eg. 70°C, to maintain the oil product liquid and mobile. The tank is heated with steam or hot water for a cold start of the engine if necessary or to maintain a working temperature. The refined oil is passed to a trimming heat exchanger to trim the temperature of the oil to the optimum temperature for direct injection into the combustion engine for optimum ignition. The actual temperature of the refined oil product is selected so as to be compatible with components seen in the injector pump and injector head.

Optionally, the fuel lines for delivering fuel to the engine are heated or modified or lagged to ensure that the lines do not gum up or clogged or otherwise become restricted during prolonged use by the solidification of the refined oil product when used as a fuel. The refined oil passes through a normal fuel filter system. The amount of fuel injected into the engine is in accordance with many parameters including the calorific value of the refined oil product.

Further, the engine can be optionally provided with a mixer such as for example a HACT mixer or similar allowing hydrogen to be added to the total fuel air mixture for admission to the cylinders of the engine prior to ignition. It is expected that the use of the oil product refined by the method and apparatus of the present invention will provide a fuel consumption of about 30-35 litres of oil per hour.

The exhaust from the combustion within the engine is passed through a scrubber to remove any ash or odours in order that the engine will satisfy current commission standards.

Furthermore, a further installation can be

provided in the exhaust system of the engine, so as to extract extra heat from the exhaust gases. The installation uses the exhaust gases in a similar manner to that of a turbo charger to generate additional energy power, heat or electricity. By being coupled to a suitable generator. In this manner the waste heat of the exhaust gases can be converted into useable power, heat, steam or the like.

The described arrangement has been advanced by explanation and many modifications may be made without departing from the spirit and scope of the invention which includes every novel feature and novel combination of features herein disclosed.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is understood that the invention includes all such variations and modifications which fall within the spirit and scope.

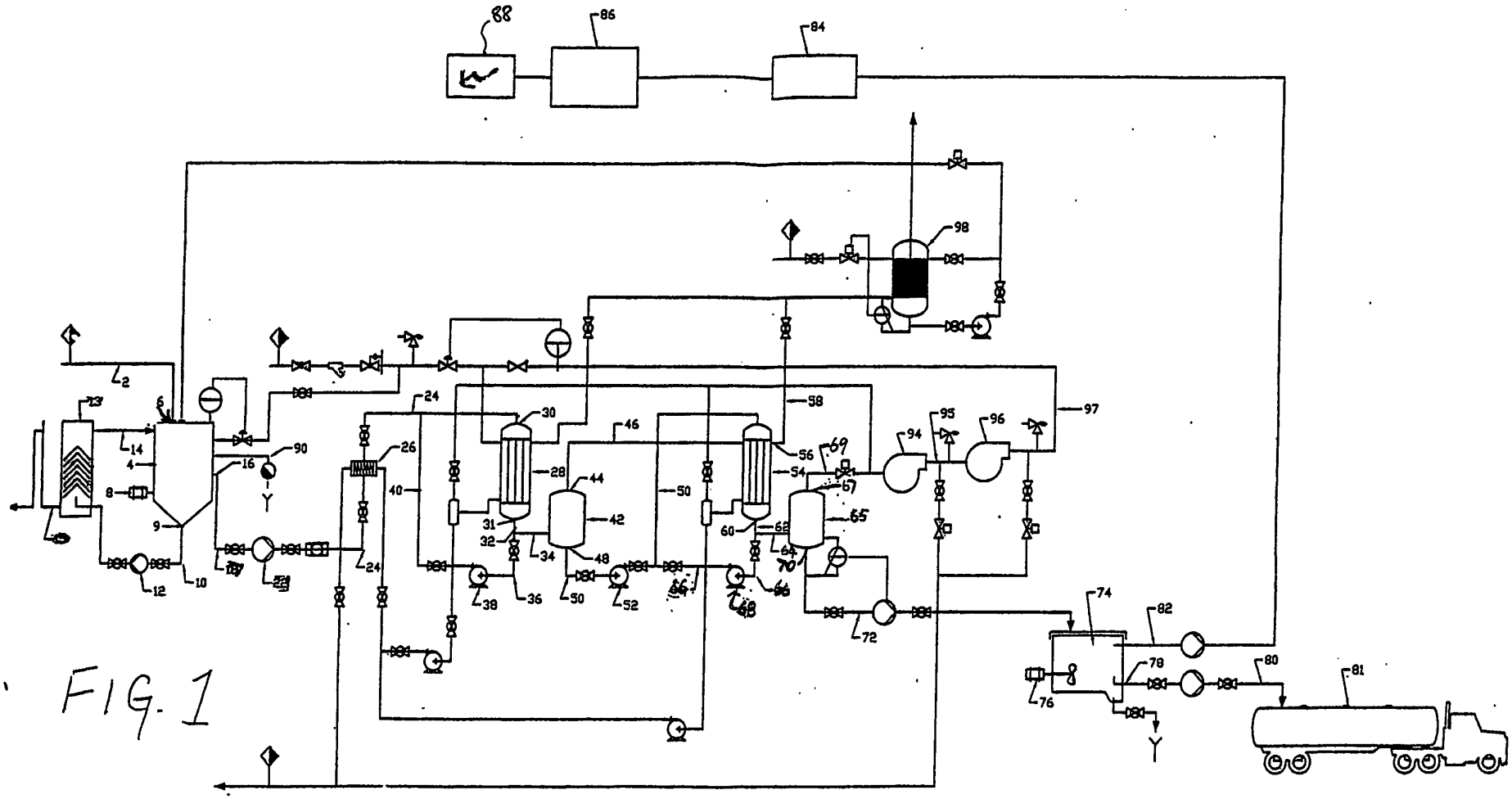
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FIG. 1

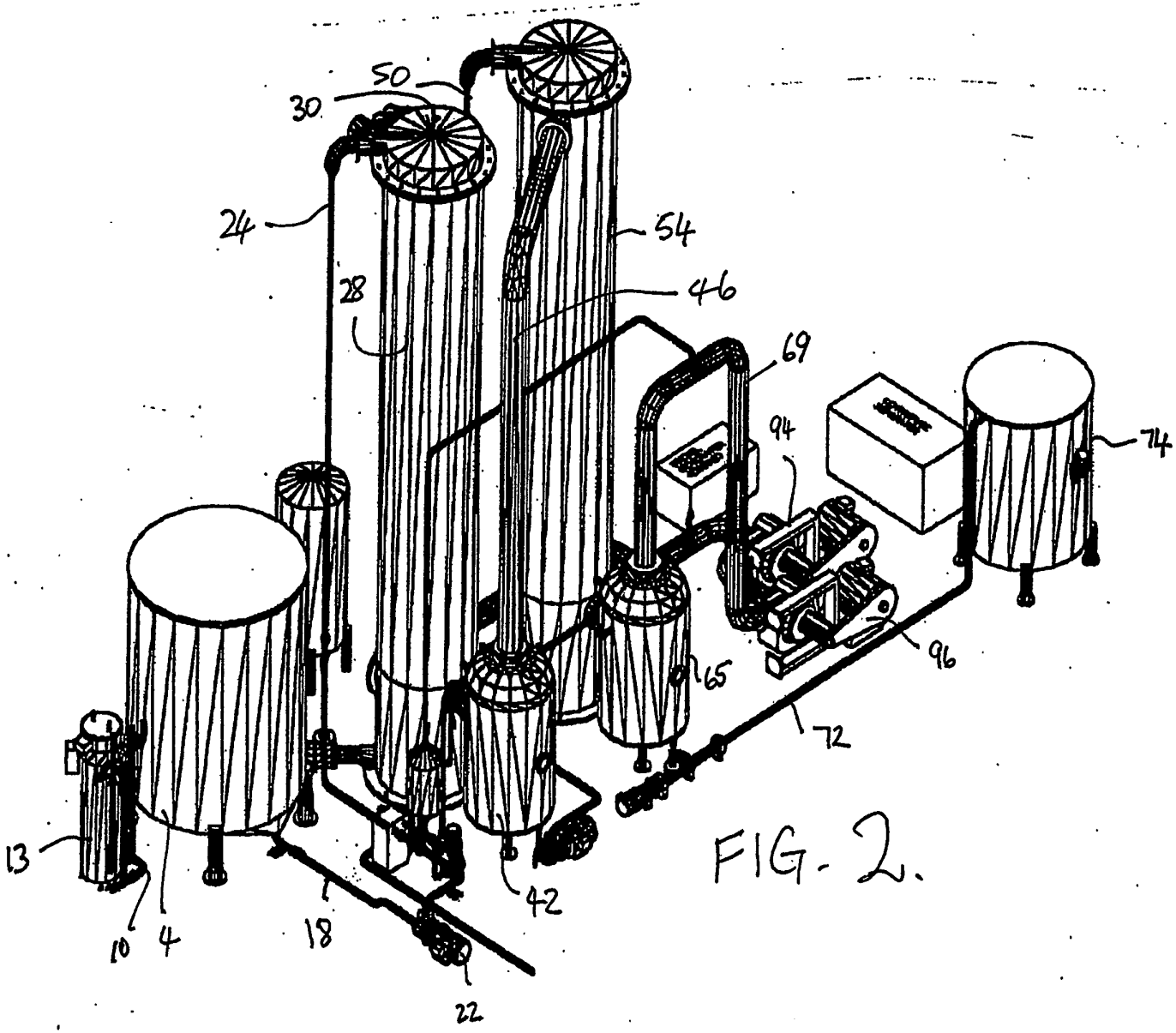

FIG. 2.